



Source: Ministry of Public Works



CHILE: MANY TIMES HURT BY NATURAL DISASTERS, PERMANENTLY BLESSED BY NATURAL RESOURCES

MANAGEMENT IN EMERGENCY CONDITIONS: 27/F EARTHQUAKE'S LESSONS



**Ministerio de
Minería**

Gobierno de Chile

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Minister of Mining
Former Minister of Public Works

Waterloo, March 2012
Conference at University of Waterloo

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I. About Chile: General description



Source: SERNATUR

CHILE: A LONG AND NARROW COUNTRY...

North



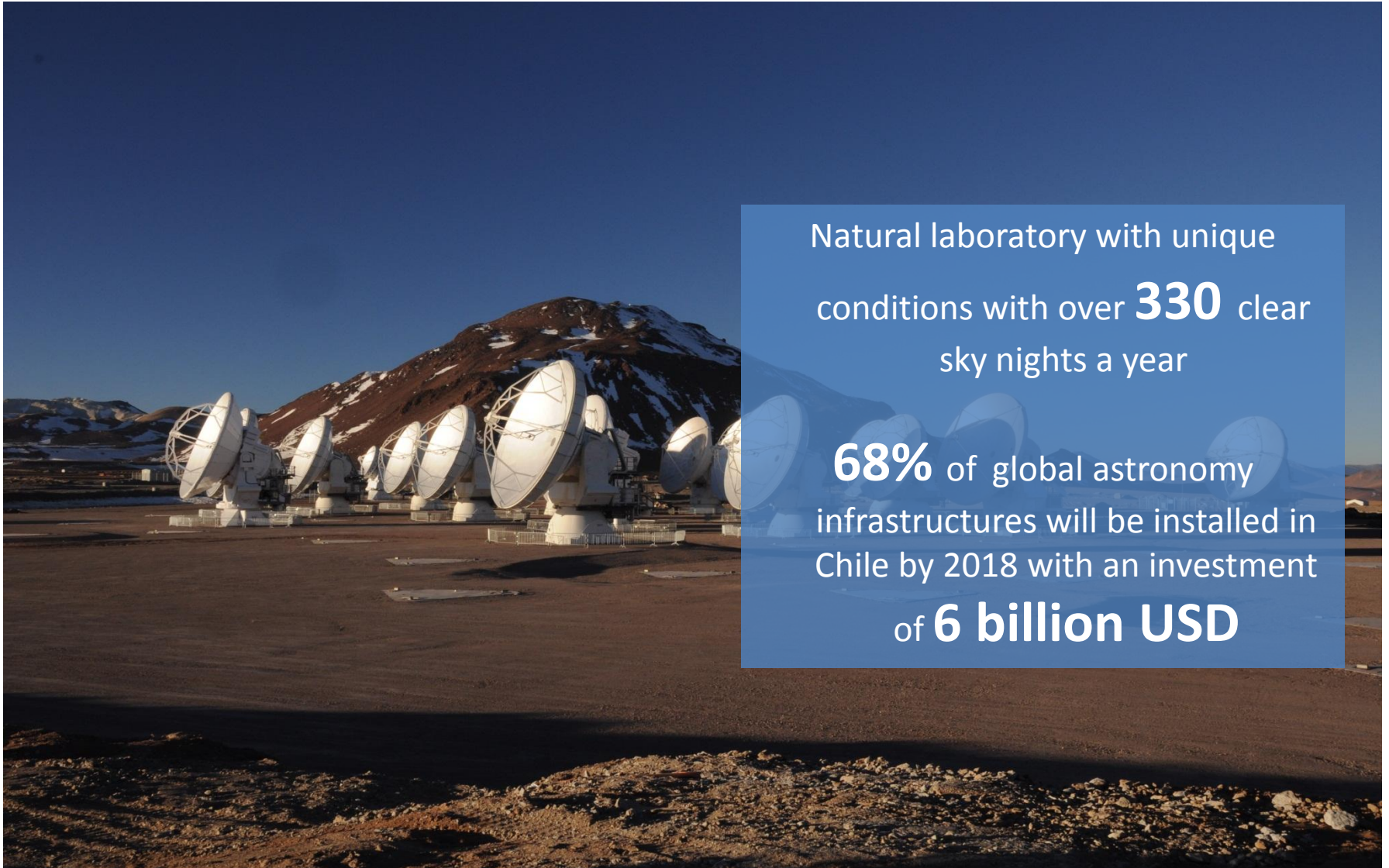
Center



South



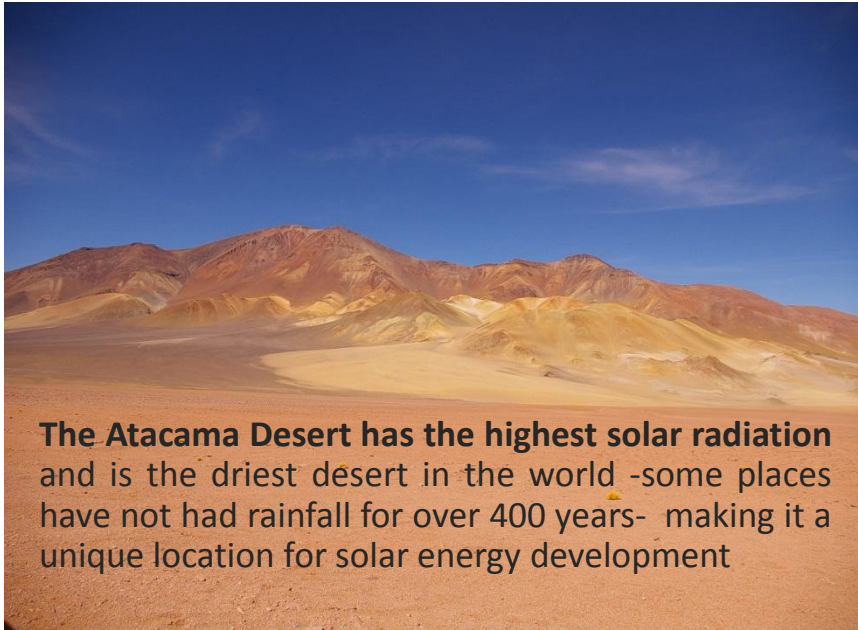
CHILE: ASTRONOMY CAPITAL OF THE WORLD, NORTH CHILE



Natural laboratory with unique conditions with over **330** clear sky nights a year

68% of global astronomy infrastructures will be installed in Chile by 2018 with an investment of **6 billion USD**

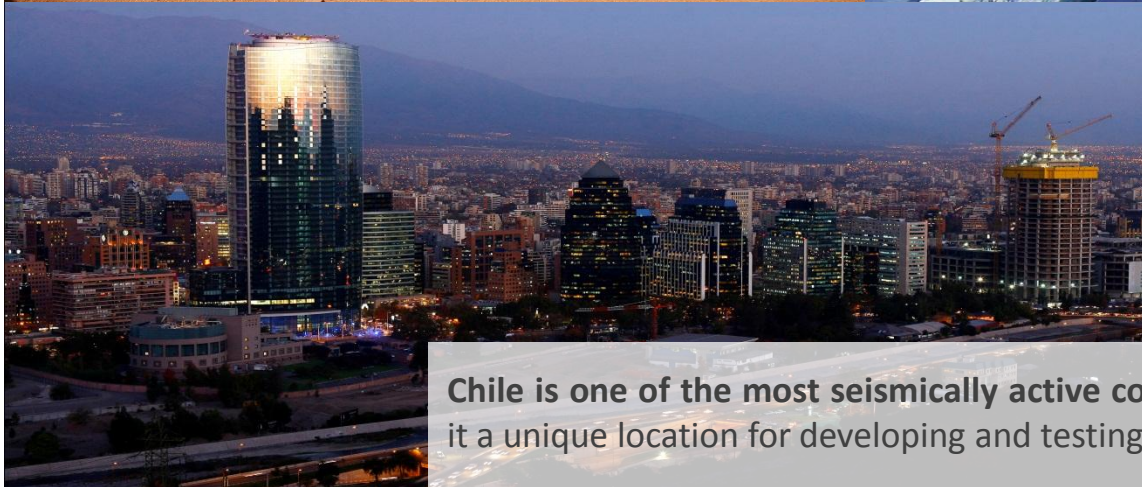
CHILE: OTHER NATURAL LABORATORIES



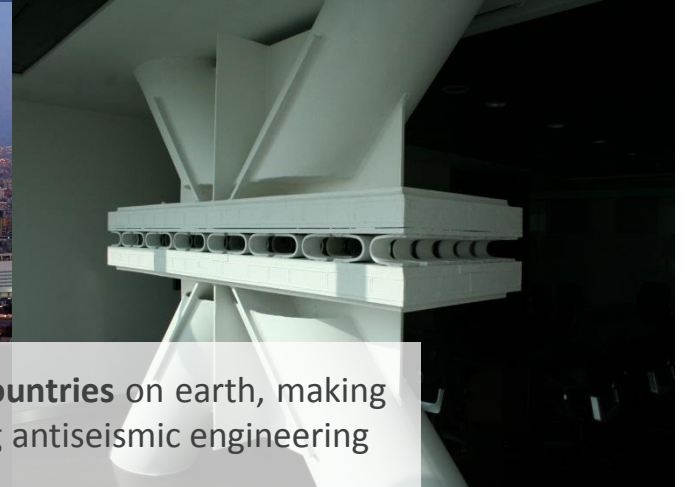
The Atacama Desert has the highest solar radiation and is the driest desert in the world -some places have not had rainfall for over 400 years- making it a unique location for solar energy development



Punta Arenas is the closest port of access to Antarctic making it a unique location for the logistics needed in science, tourism and fishing in Antarctic

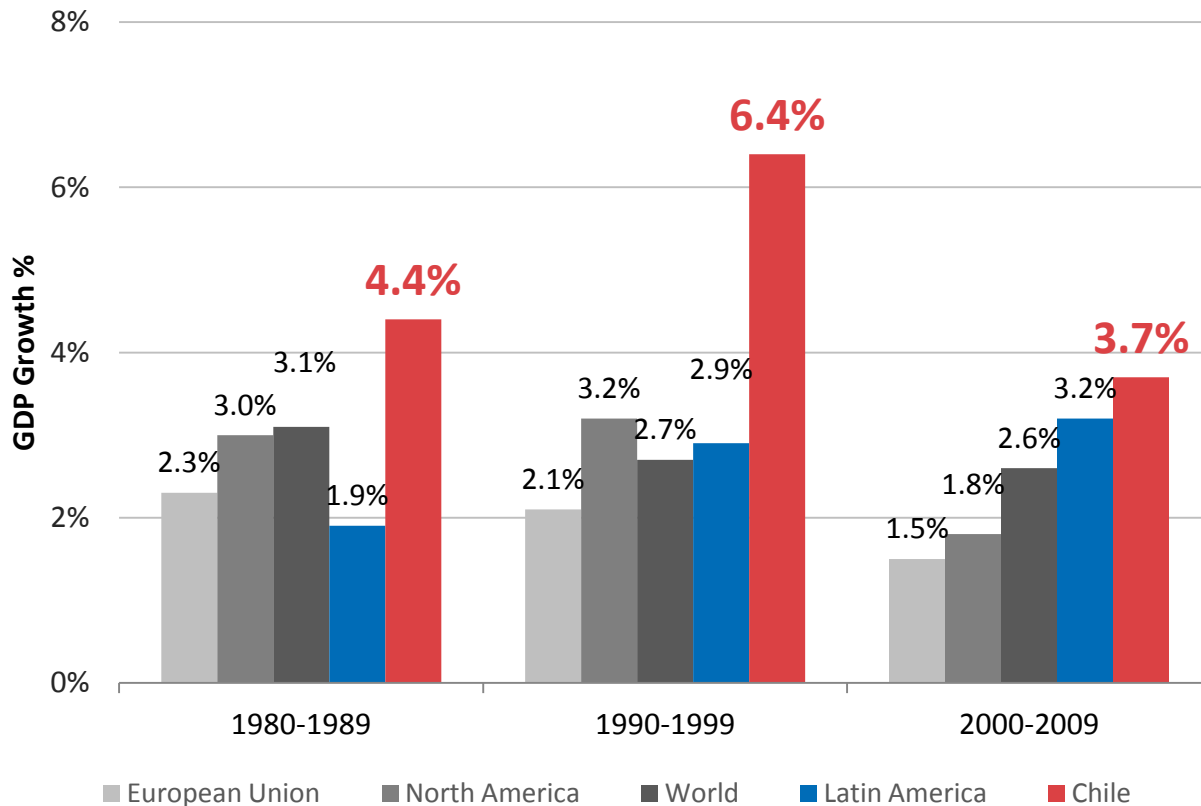


Chile is one of the most seismically active countries on earth, making it a unique location for developing and testing antiseismic engineering



SOLID GROWTH AND STABLE INSTITUTIONS

Economic Growth in the Past Decades



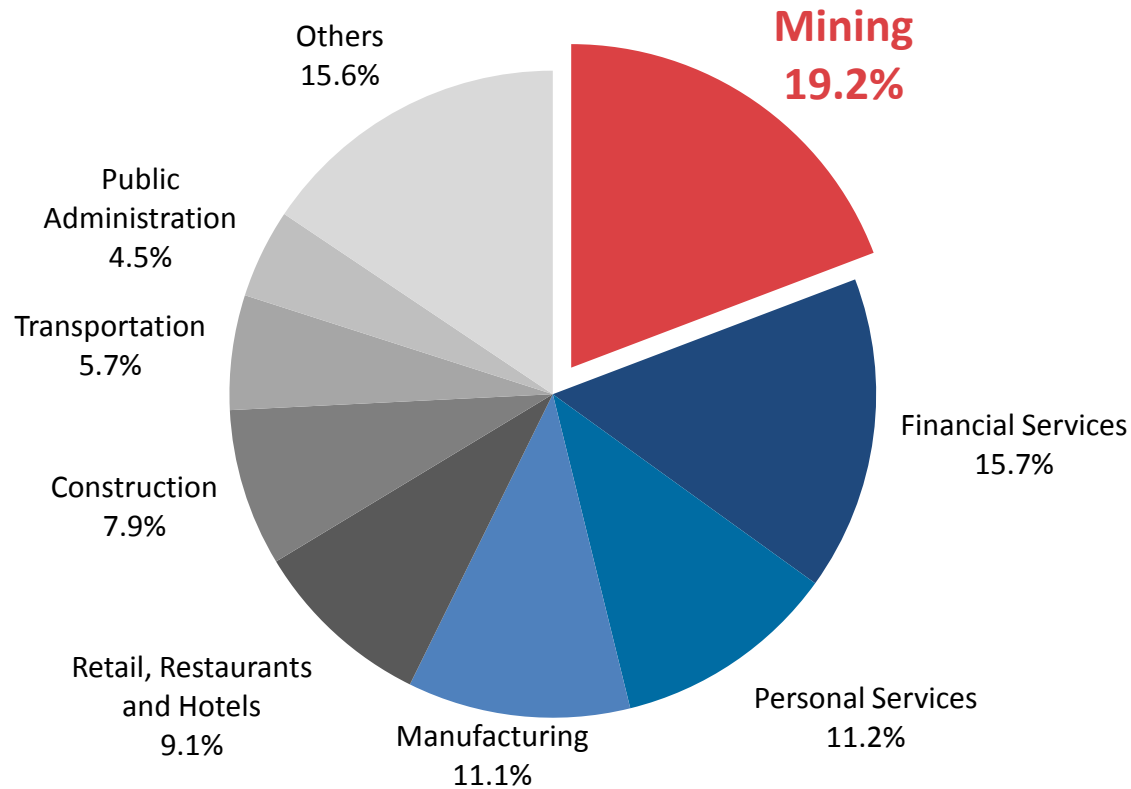
Source: World Bank and Central Bank of Chile, 2012

Chilean economic and institutional stability has been broadly recognized by the international community. Key factor in achieving economic growth in recent decades.

Chile GDP grew 6.3% last year and is forecast to grow in the range 3.75%-4.75% by 2012.

A MINING COUNTRY

Chile's GDP by Economic Sector (2010)

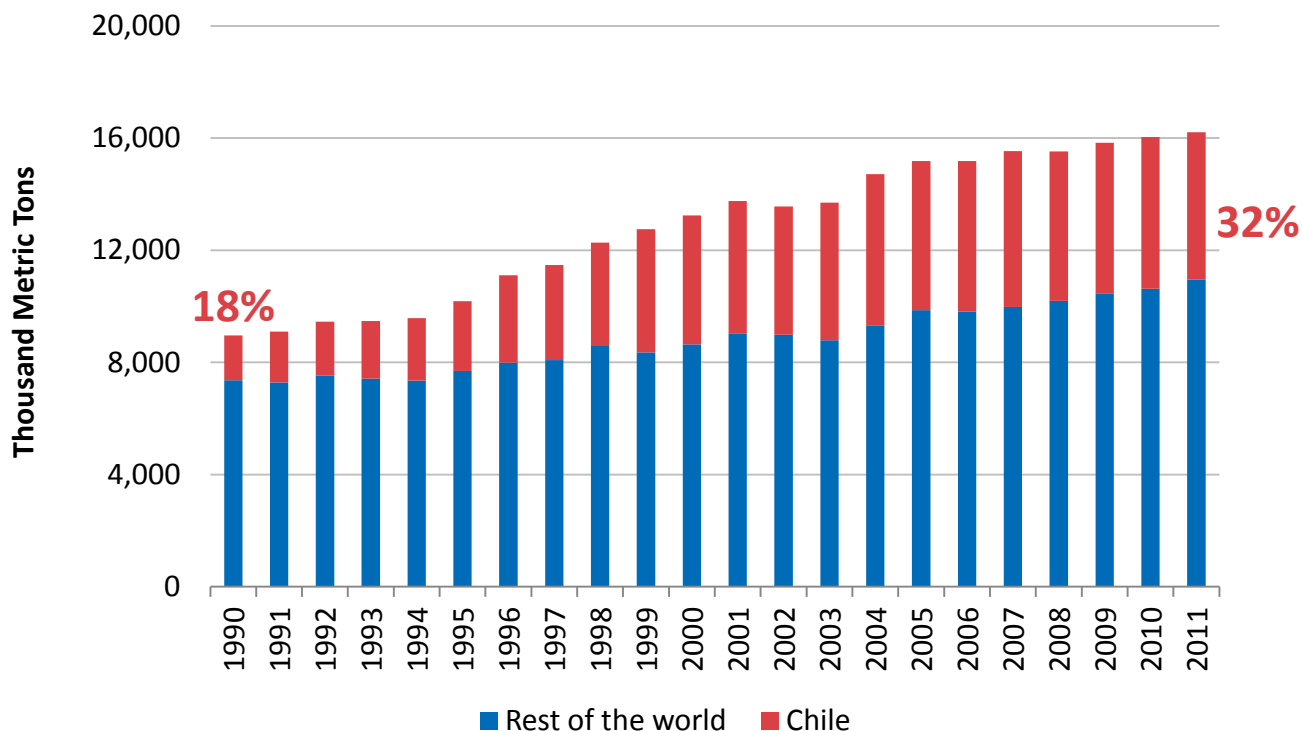


Source: Central Bank of Chile, 2011



The share of mining in Chile's GDP has increased from 7% in 2000 to 19% by 2010.

GROWING PARTICIPATION OF CHILE IN WORLD PRODUCTION OF COPPER

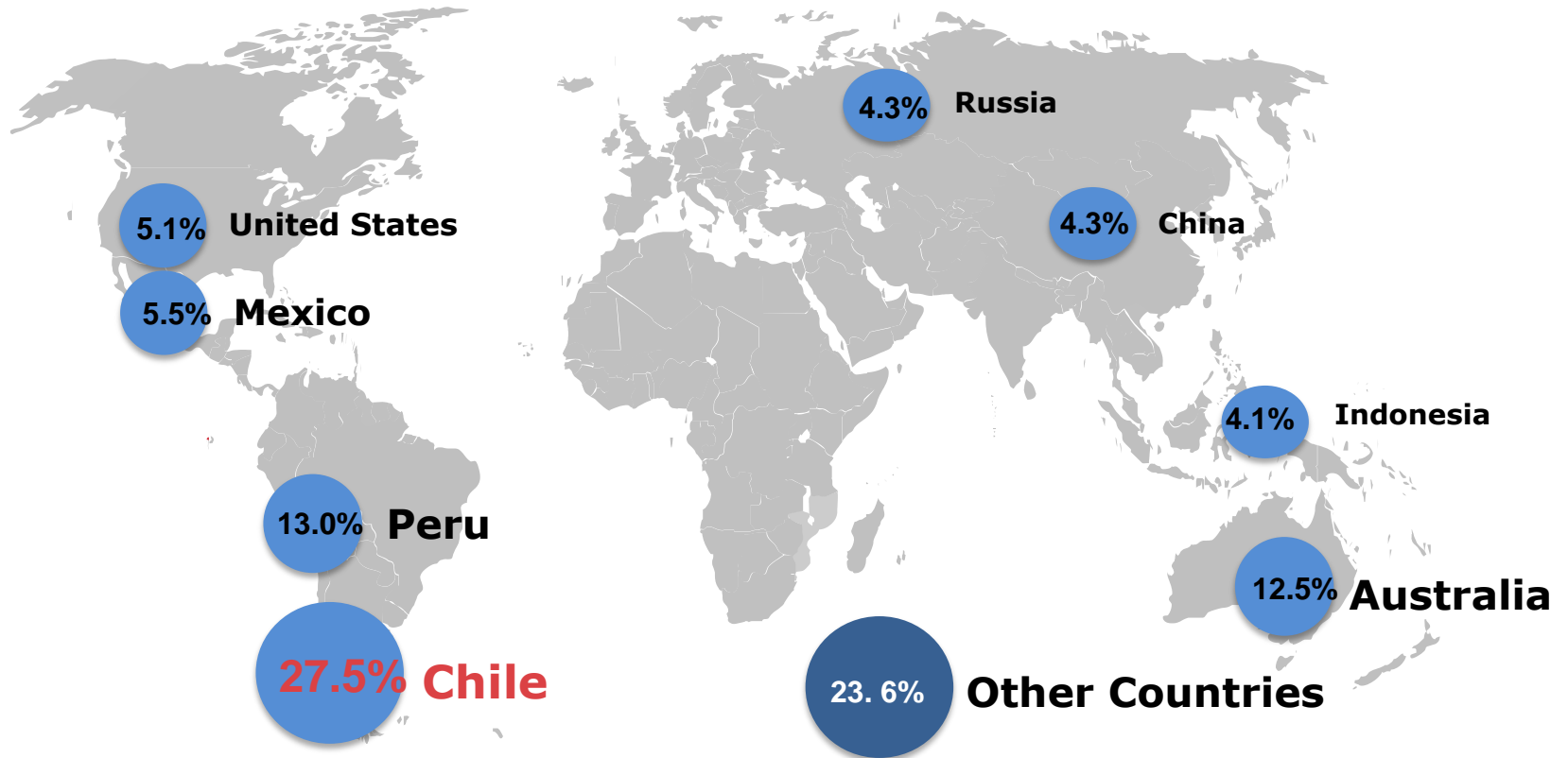


Chile has tripled its copper production in the last twenty years, increasing its participation in the world production and strengthen its leadership.



Source: Chilean Copper Commission, 2012

2011 WORLD COPPER RESERVES DISTRIBUTION



Source: USGS, 2012

Chilean copper reserves represent 27.5% of world total reserves. In its latest report, the USGS rose Chilean copper reserves from 150 to 190 million tons.



II. Earthquakes and Catastrophes: *International Outlook*





LARGEST EARTHQUAKES RECORDED

- 
- 1** **Valdivia**, May 22, 1960, Chile
9,5 Richter. 1.655 fatal victims
 - 2** **Alaska**, March 28, 1964, United States of America
9,2 Richter. 128 fatal victims
 - 3** **Sumatra Island**, December 26, 2004
9,0 Richter. 227.898 fatal victims
 - 4** **Tohoku**, March 11, 2011, Japan
9,0 Richter. 14.941 fatal victims
 - 5** **Kamchatka**, November 4, 1952, Russia
9,0 Richter. No fatal victims
 - 6** **Concepción/Constitución**, February 27, 2010, Chile
8,8 Richter. 524 fatal victims.

INTERNATIONAL CATASTROPHES AND RECONSTRUCTION RESPONSE (1/2)

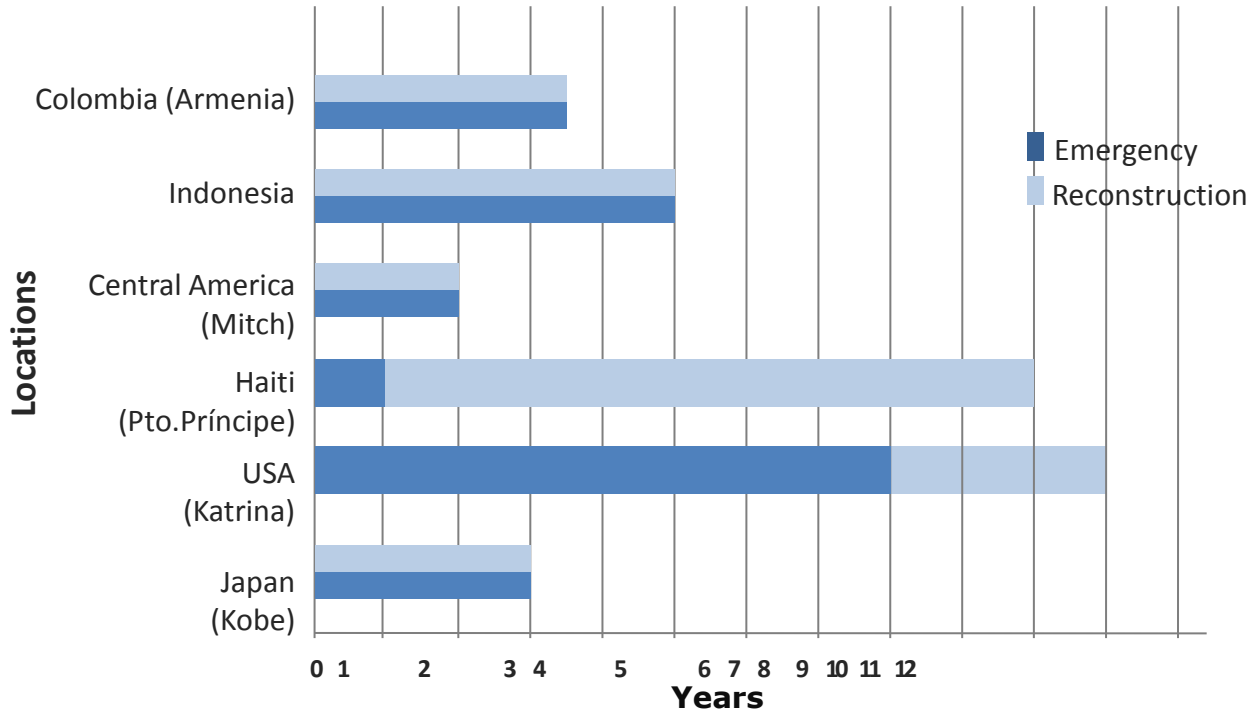
	Houses affected	Date	Catastrophy	Magnitude
Colombia (Armenia)	129,619	January 1999	Earthquake	6.2 Richter
Indonesia	213,503	December 2004	Earthquake	9.1 Richter
Central America (Mitch)	41,420	October - November 1998	Hurricane	5 Saffir-Simpson
Haiti (Port au Prince)	188,383	January 2010	Earthquake	7 Richter
USA (Katrina)	1,125,791	August 2005	Hurricane	5 Saffir-Simpson
Japan (Kobe)	394,440	January 1995	Earthquake	7.2 Richter

Source: Reconstruction balance, Office of the President



INTERNATIONAL CATASTROPHES AND RECONSTRUCTION RESPONSE (2/2)

Approximate time in Reconstruction After the Catastrophe



Source: Reconstruction balance, Office of the President



CHILE: A SEISMIC COUNTRY

San Antonio, 1985 - 7,7 °Richter
From V to VI regions

Cobquecura, 2010 - 8,8 °Richter
From V to IX Regions

Valdivia, 1960 - 9,5 °Richter
From VII to X Regions



Chile is considered one of the most seismically active countries, due to the Pacific Ring of Fire

Source:Ministry of Public Works



III. 27/F Case Study: *Damage Assessment*

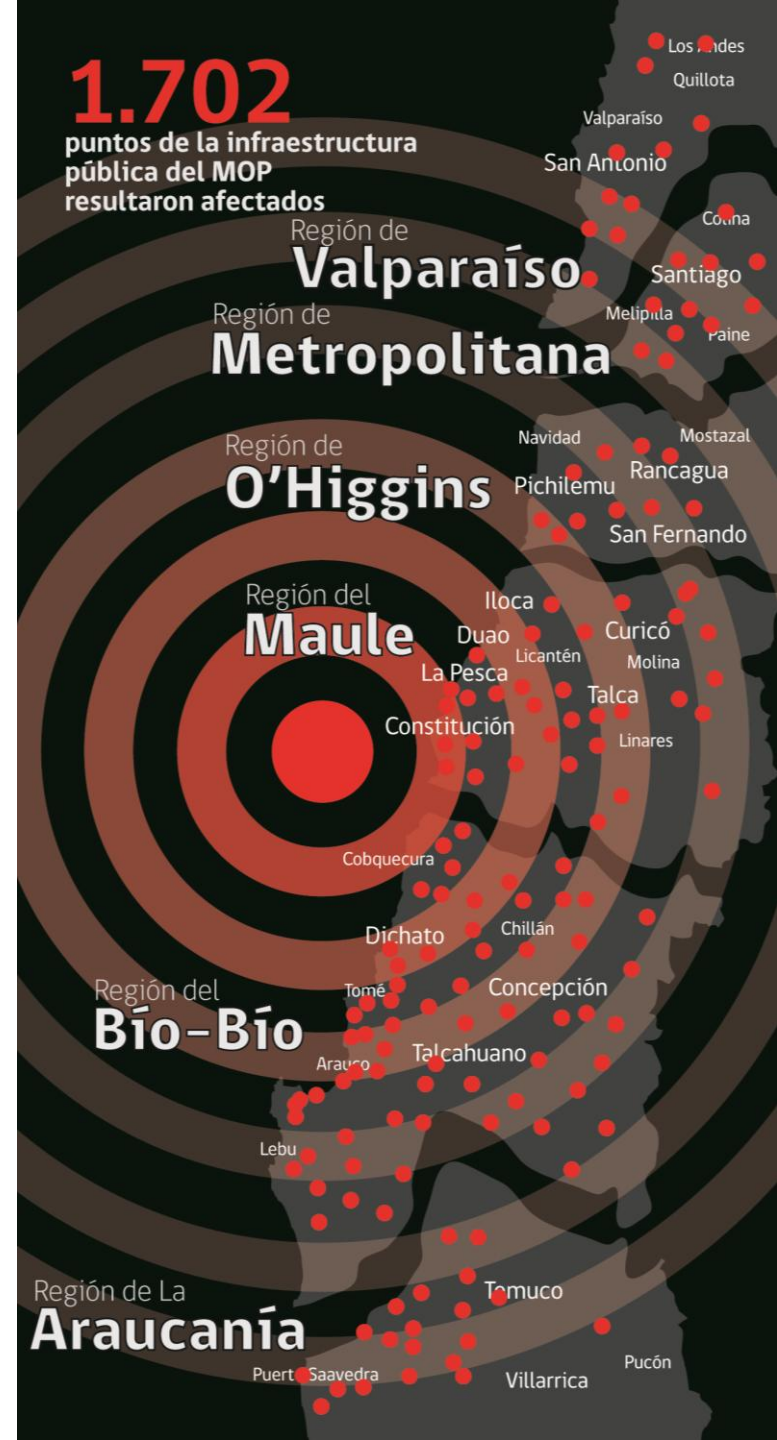




MAGNITUDE

- Time: 3:34 am
- Magnitude:8,8 Richter Scale
- More than 630 kilometers of the national territory affected
- 12.800.000 people affected, equivalent to the 75% of the national population

Source:Ministry of Public Works



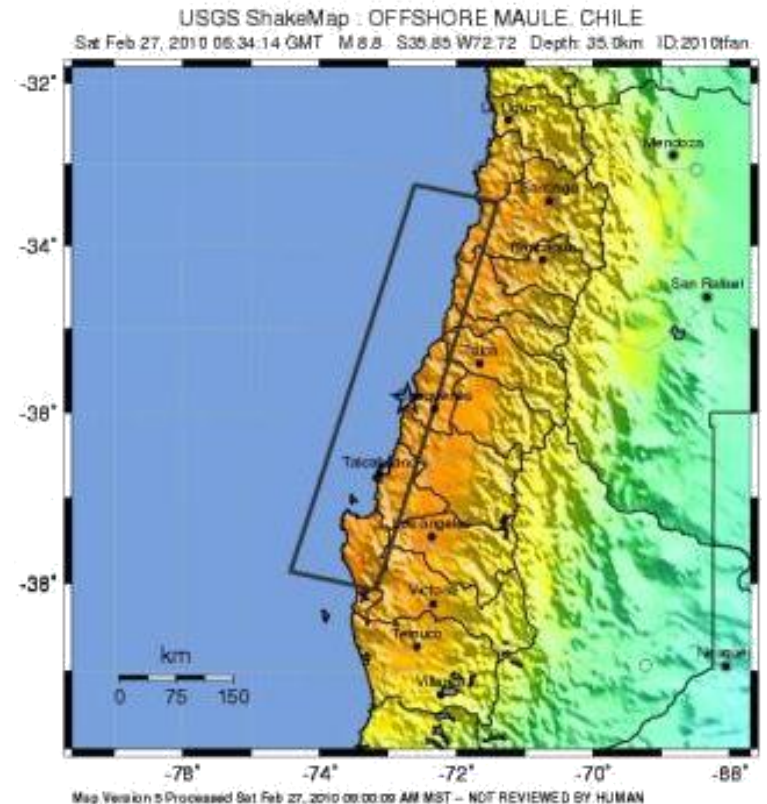
DAMAGE

Complexity: damage dispersion

- 6st greater earthquake
- Affected to 6 regions (of 16)
- 630 kilometers of coast
- Houses affected, equivalent to 220.000
- 75% of the national population was affected

Most affected cities

- Concepción Downtown
- 5 cities over 100,000 inhabitants
- 45 cities over 5,000 inhabitants
- More than 900 towns and communities



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate-Heavy	Heavy	Very Heavy
PEAK ACC (mg)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VSL (cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL SEVERITY	I	II-III	IV	V	VI	VII	VIII	IX	X

Source: U.S. Geological Survey



CONSEQUENCES OF THE CATASTROPHE

- Fatalities: 521
- Dissappeared: 56
- Homes destroyed or damaged: 220.000 (11% of total area affected)
- Hospitals destroyed or damaged: 79 of 130 (22% critical and standard hospital beds; 39% of hospital operating rooms)
- Schools destroyed or damaged: 3.049 (76% of total schools in affected area)
- Bridges destroyed or damaged: 221
- More than 900 towns, rural and coastal communities
- Initial estimated cost for Chile (damage and loss of product):

US\$ 30 Billion. 17% of GDP

Source: Ministry of Public Works



40% of Rural Potable Water Supply Systems in the country were damaged.





Damage



**APR Champa – Hospital
Metropolitan Region
March 2010**

Source: Ministry of Public Works



1,554 Km of roads and 92 km of concessioned highways





Damage examples



San José de Apalta

O` Higgins Region

02.28.10

Source:Ministry of Public Works



Damage examples





Damage examples



Vespucio Sur Highway

Source :Autospista Vespucio Sur

210 Bridges

Including the two most important of the Bio Bio Region, which affected more than 4,500 trucks and over 400,000 private vehicles.





Damage Examples




Tubul Bridge
March 2010

Source : ONEMI

28 fishing coves and 7 piers





**14 canals, 6 reservoirs, 54 river defenses,
21 rainwater collectors.**





Damage Examples





Damage Examples



Irrigation system
Digua Main Channel
Maule Region

Source: Ministry of Public Works



Damage Examples





Damage Examples



**Alto Rio Building
Concepcion**

Source : ONEMI



Damage Examples



Fill Collapse



IV. **27/F Case Study:** *Emergency and Reconstruction*





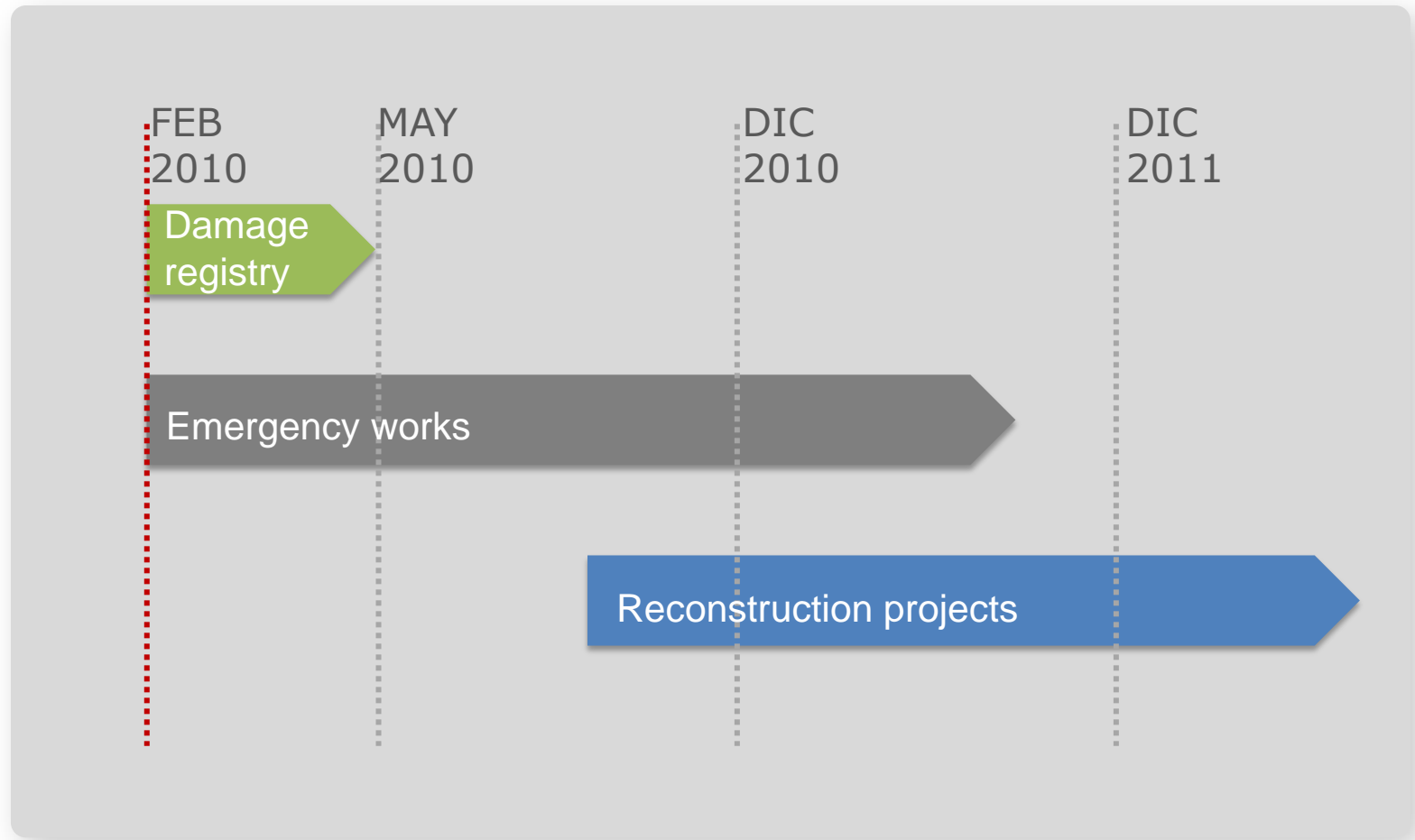
RECONSTRUCTION: CHILEAN CASE

After the catastrophe, the MOP established three priorities for early recovery:

- ✓ Accelerate the availability of **drinking water** in **urban and rural areas**
- ✓ Recover the **connectivity of the country**, and gradually improve its standards
- ✓ Recover the **minimum functionality of public infrastructure** to help survival and basic economic activities, such as fishing coves

Source: Ministry of Public Works

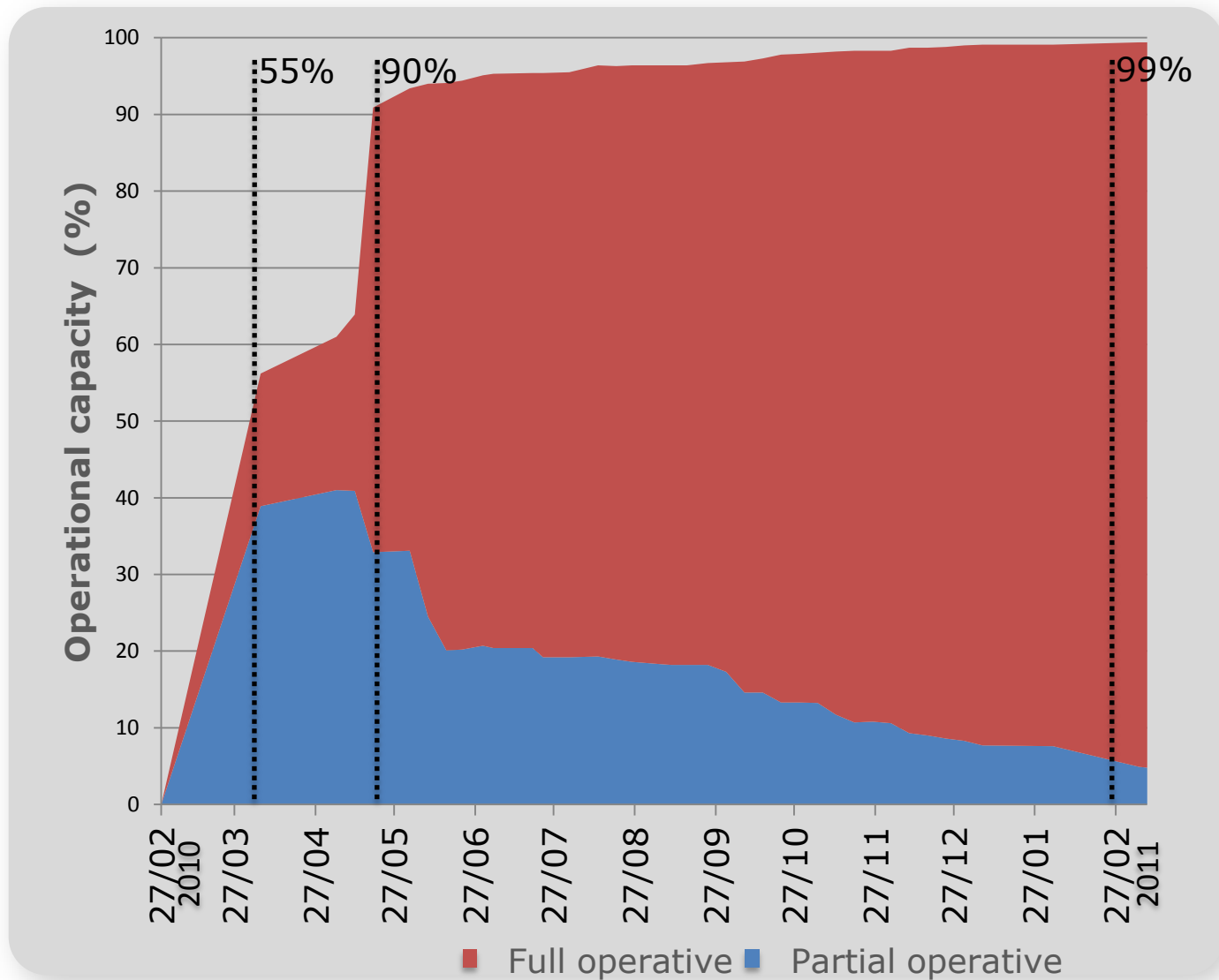
MOP EXECUTION TIME: STAGES OF EMERGENCY AND RECONSTRUCTION RESPONSE



Source: Ministry of Public Works



MOP EXECUTION TIME: OPERATIONAL CAPACITY RECOVERY



Source: Ministry of Public Works



FAST RECOVERY OF PUBLIC INFRASTRUCTURE

Today, **99%** of the public infrastructure of the country that suffered damage by the earthquake has recovered its basic functionality (operational), in partial or complete form.

Source: Ministry of Public Works



100% of the total of **1,554 km**
of roads damaged

Hospital Overpass

Source: Ministry of Public Works



100% of ports.





99% of damaged bridges



100% of airports and aerodromes

Arturo Merino Benitez Airport Santiago

Source: Ministry of Public Works



100% of potable water systems of rural areas



100% of canals and reservoirs



Canal Melozal Maule

Source: Ministry of Public Works



San José de Apalta O'Higgins Region

Source: Ministry of Public Works



North Lota Access Bio-Bio Region

Source: Ministry of Public Works



Irrigation System



Digua Main Canal Maule Region

Source:Ministry of Public Works



APR Champa – Hospital Región Metropolitana

Source: Ministry of Public Works



Mecano Bridge over Rio Claro Maule Region

Source: Ministry of Public Works



V. Other Case Studies





The White Earthquake





The White Earthquake

Source: Ministry of Public Works





Puyehue Volcano





Puyehue Volcano





Hudson Volcano





Hudson Volcano



Source:



33 Miners



Source :Office of the President

33 Miners



Source :Office of the President



VI. **27/F Case Study:** *Learned Lessons*



The prevention-and-reaction model to catastrophes that affect infrastructure

Prevention

Prevention

- ✓ Public coordination
- ✓ Regulatory changes
- ✓ New Public Ministry attributions
- ✓ Protocols
- ✓ Telecommunications infrastructure
- ✓ Risk studies (flooding, earthquakes, volcanic activity, tsunami, others)

Reaction



Learned Lessons



Source: Ministry of Public Works



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